Compost Operators Training Certificate Course:

The Biology and Core Principles of Composting

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Definition of Composting is:

An aerobic process in which microorganisms decompose various organic materials to yield CO_2, water, and a stable, soil-like product called compost, or humus. The controlled process of decomposition.

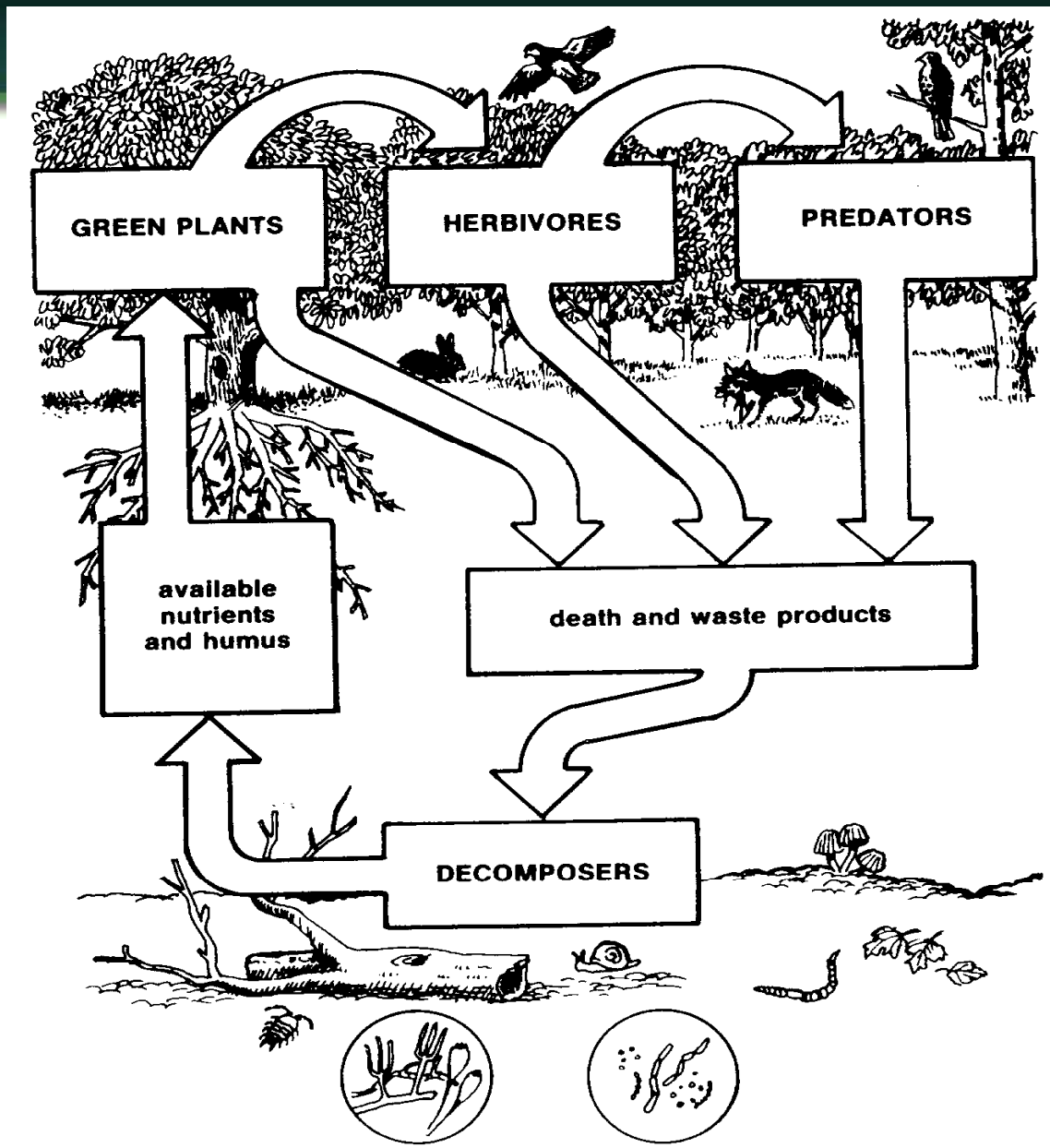
Terms you will hear today

- Compost (just mentioned)
- Humus (not hummus)
- Aerobic (with oxygen)
- Anaerobic (without oxygen)
- C:N (carbon to nitrogen ratio)
- Biodegradable (biological decomposition possible not to be confused with “compostable”)
- MRF (Material Recovery Facility)

Objective of Composting

The Composting Process

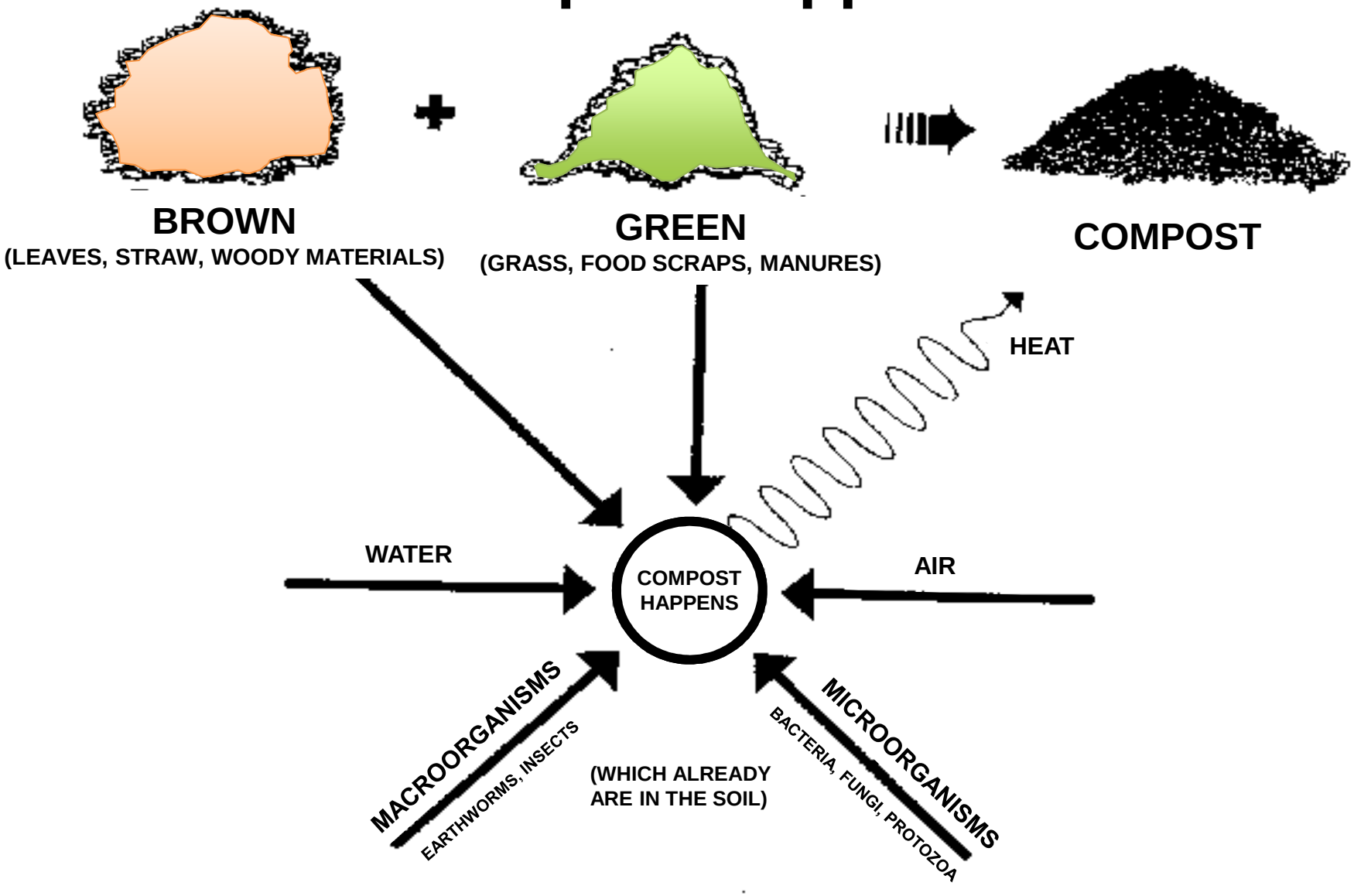
1. Microbial breakdown of organic matter
2. Reduction in particle size
3. C:N ratio decreases due to carbon loss
4. Odors occur due to gasses & VFAs
5. pH rises above neutrality
6. Volume reduction of 50-60%
7. Weight reduction of 40-80%



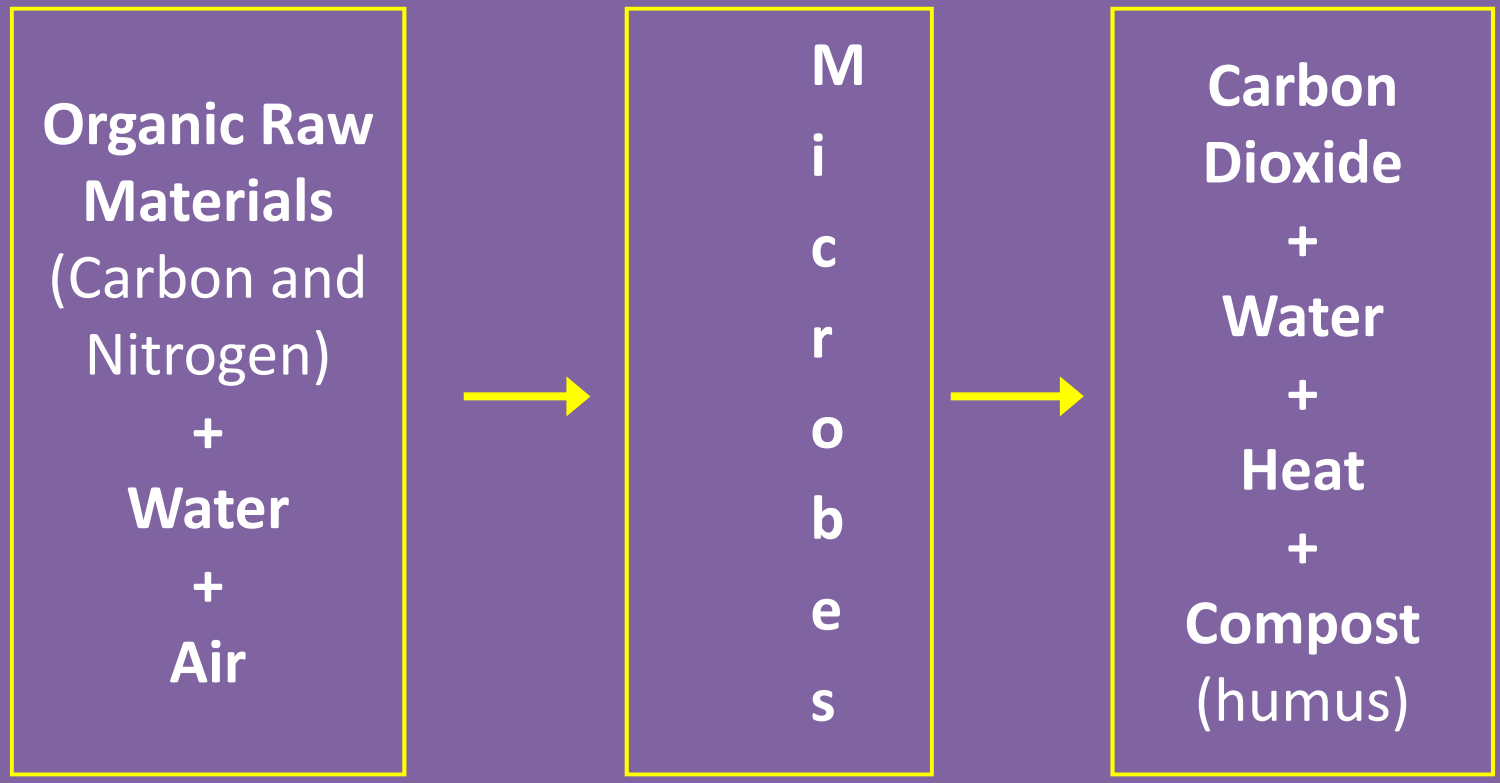
In the forest, nutrients are recycled through the natural decomposition of plant and animal waste.

Decomposition Cycle

Compost Happens



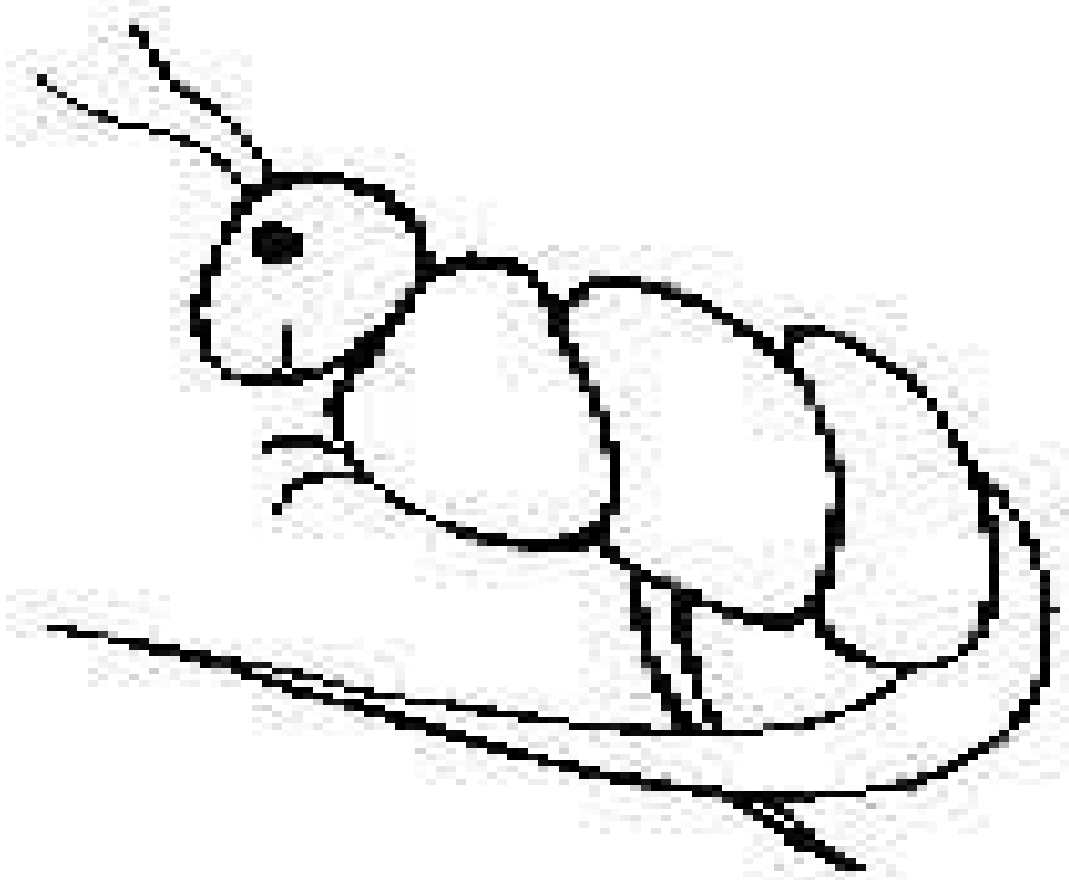
The Composting Process



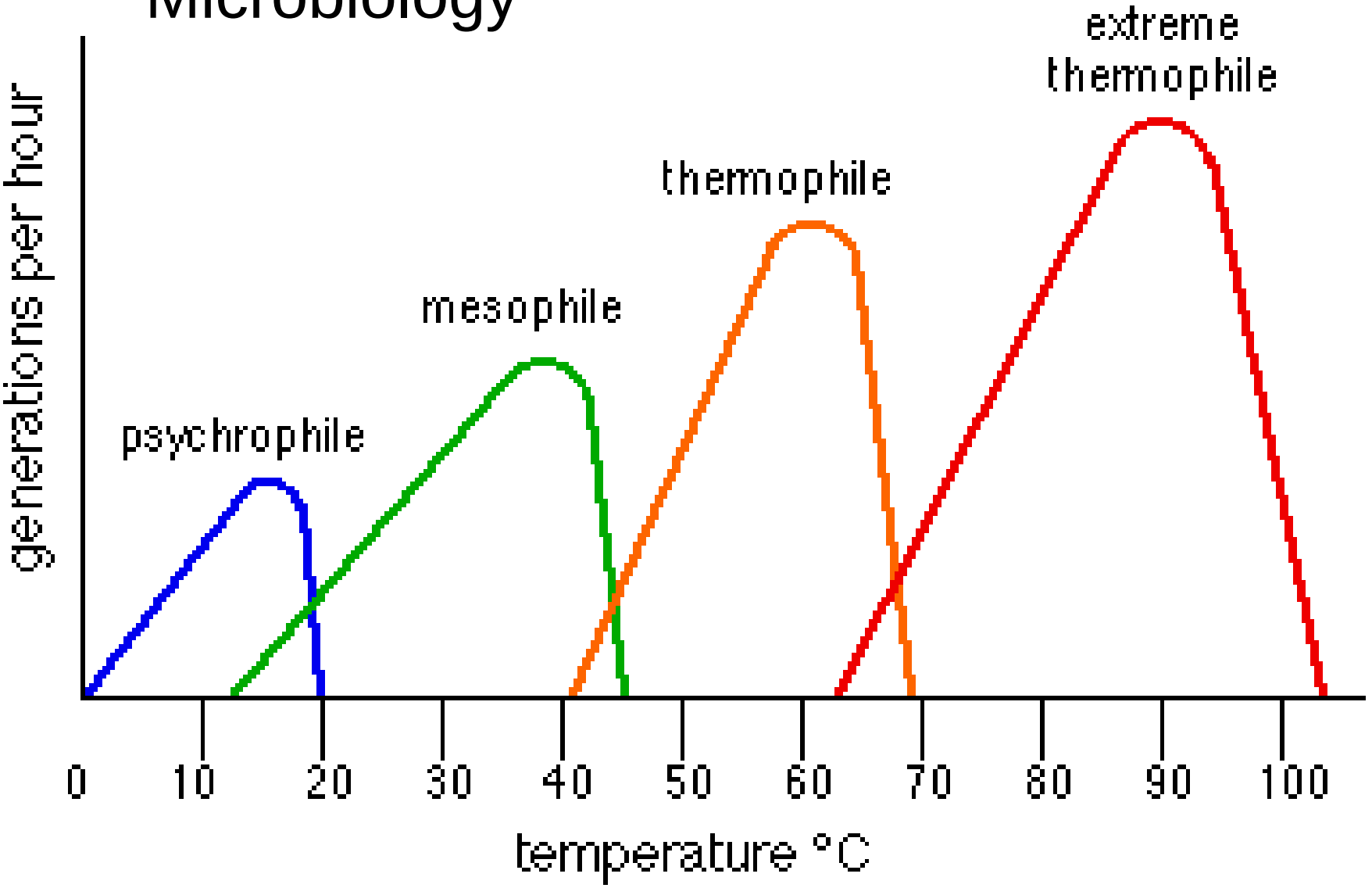
Aerobic vs. Anaerobic

- Aerobic Decomposition:
  - Decomposition of organic matter by microorganisms in the presence of air
  - By-products of aerobic decomposition are carbon dioxide and water.
- Anaerobic Decomposition:
  - Decomposition by microorganisms in the absence of air.
  - By-products include methane gas, alcohols or other organic compounds and carbon dioxide.

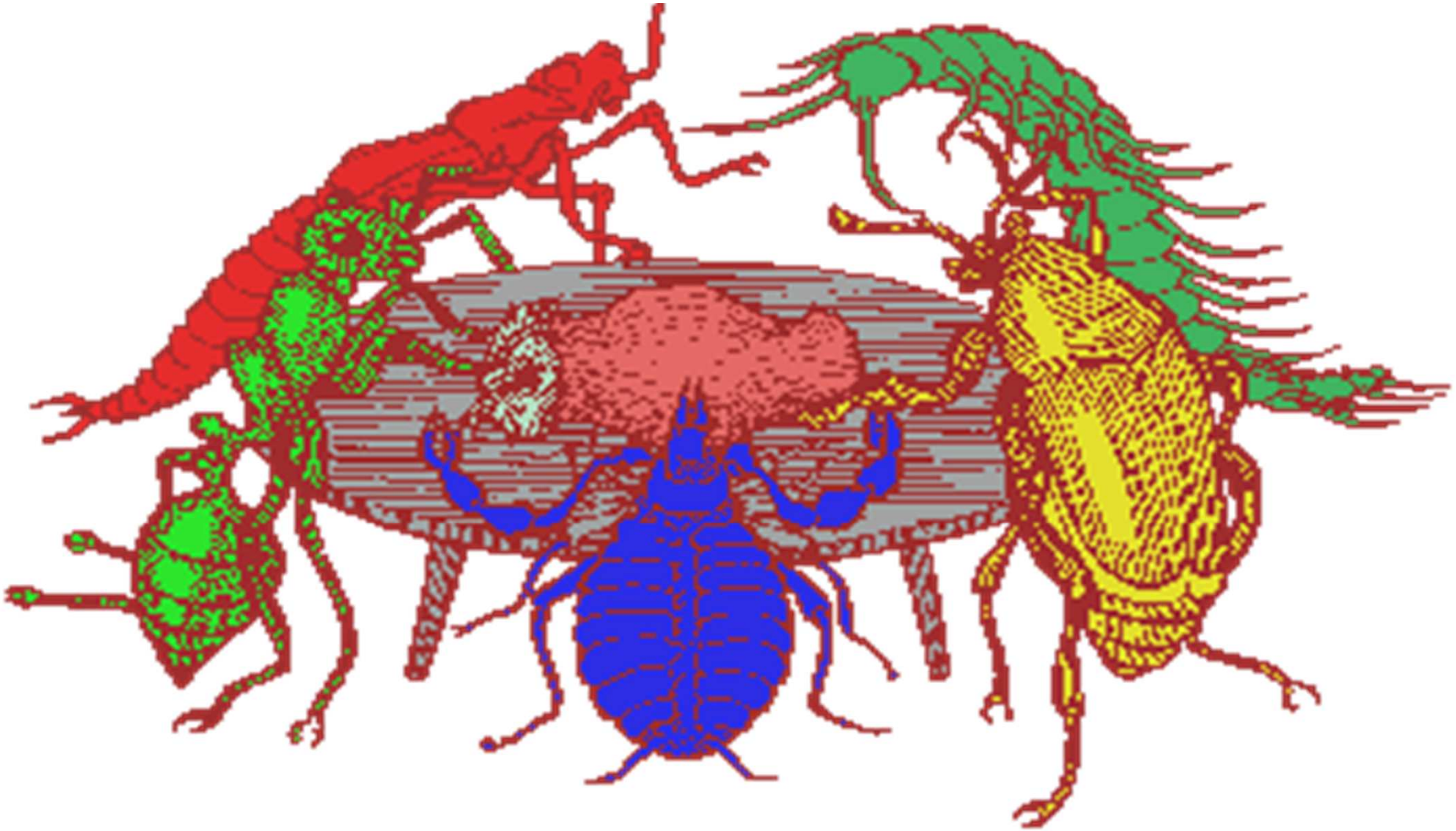
Microbes



Microbiology



Common Compost Organisms

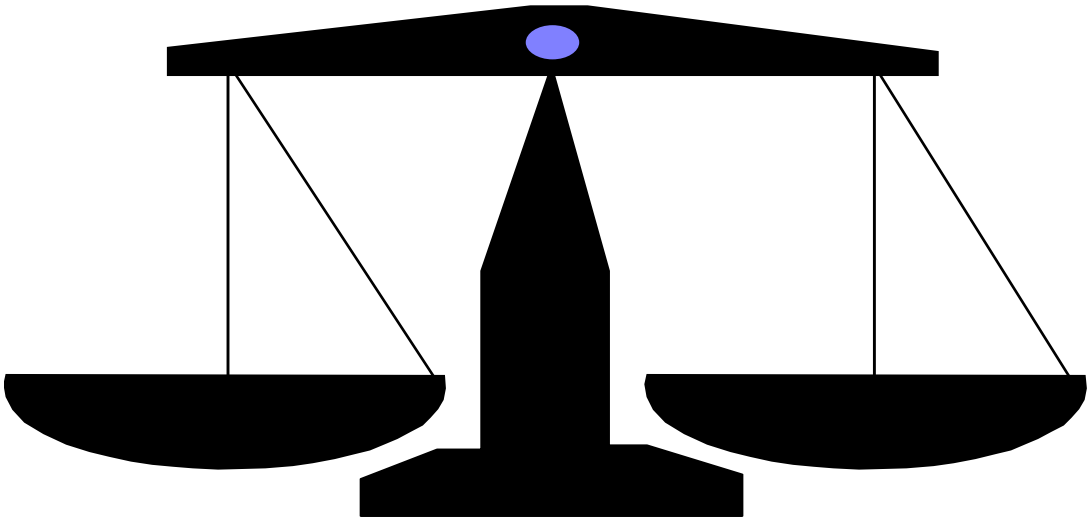


Let's talk about:
Chemical Factors Affecting Composting

Carbon to Nitrogen Ratios for Common Composting Materials

C:N Ratio by weight - 30:1

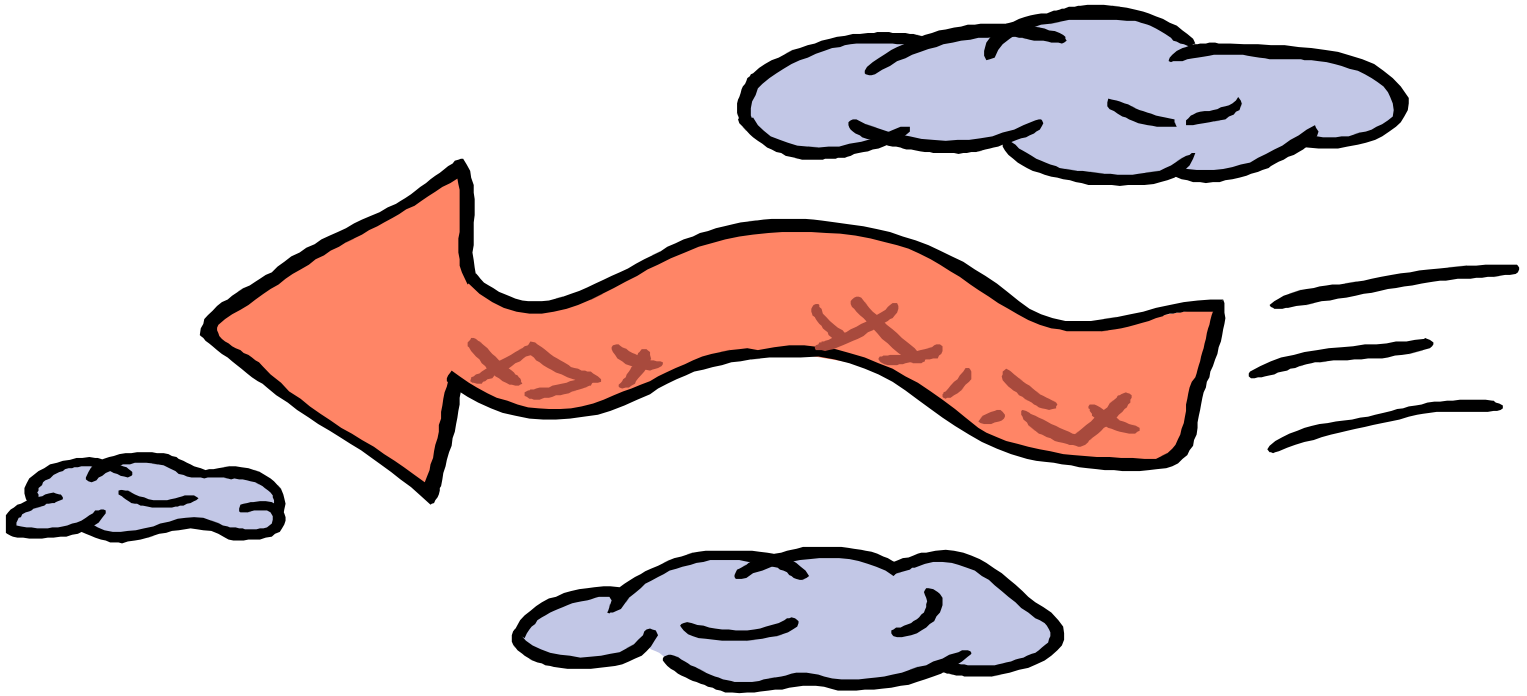
C:N Ratios by volume - 2:1



Carbon to Nitrogen ratios for common materials (by weight)

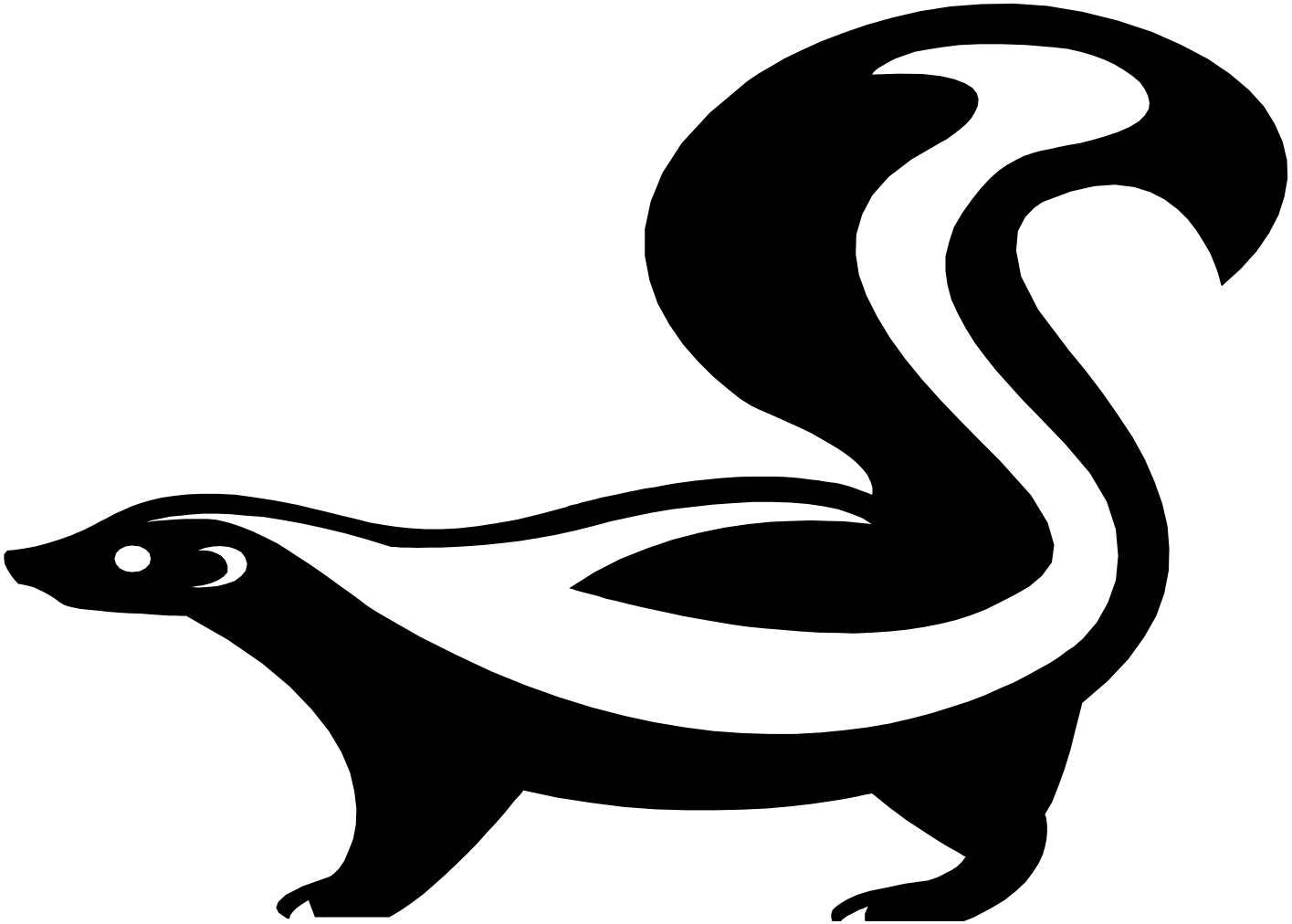
Material	C:N Ratio
Leaves	30-80:1
Sawdust	200-500:1
Straw	40-100:1
Manure	20-60:1
Coffee grounds	20:1
Vegetable wastes	12-20:1
Grass	12-25:1
Wood chips	500-700:1
Seaweed	19:1

Aerobic Decomposition



Oxygen (gasses)

Anaerobic Decomposition



Nutrients

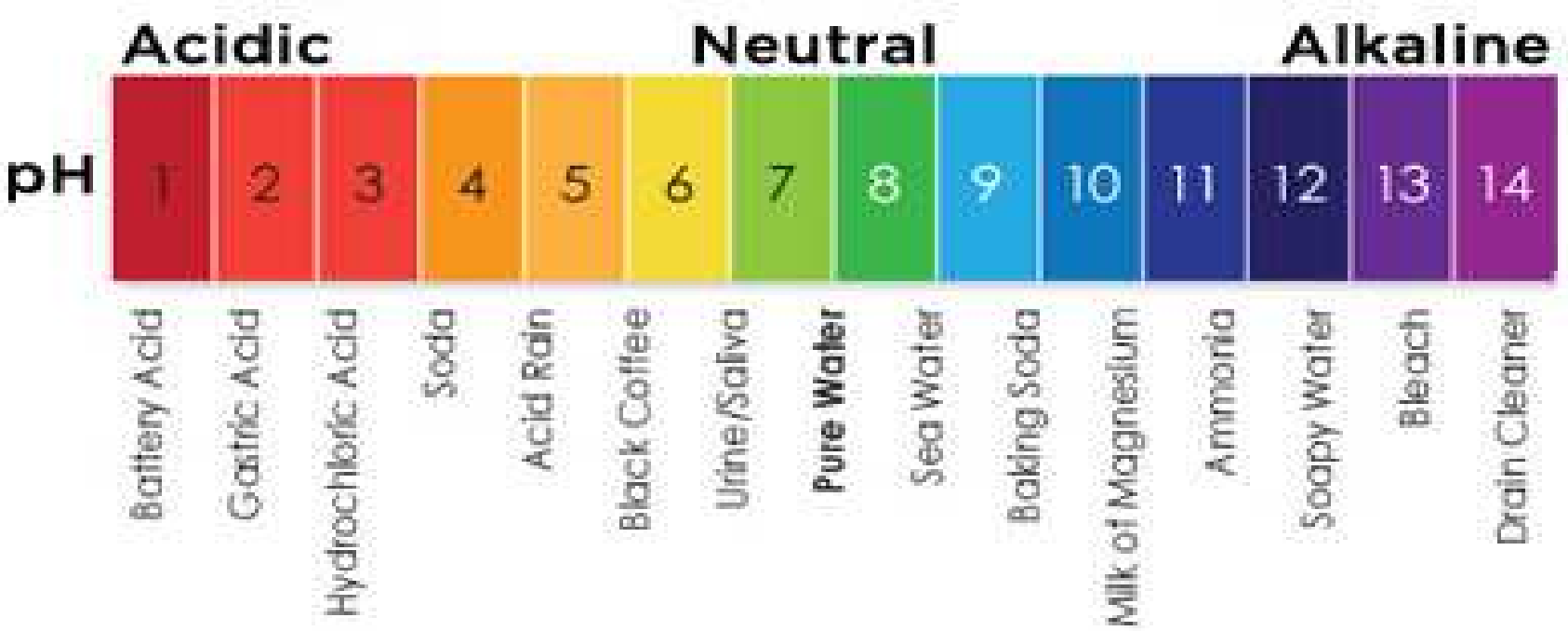
H O P K I N S

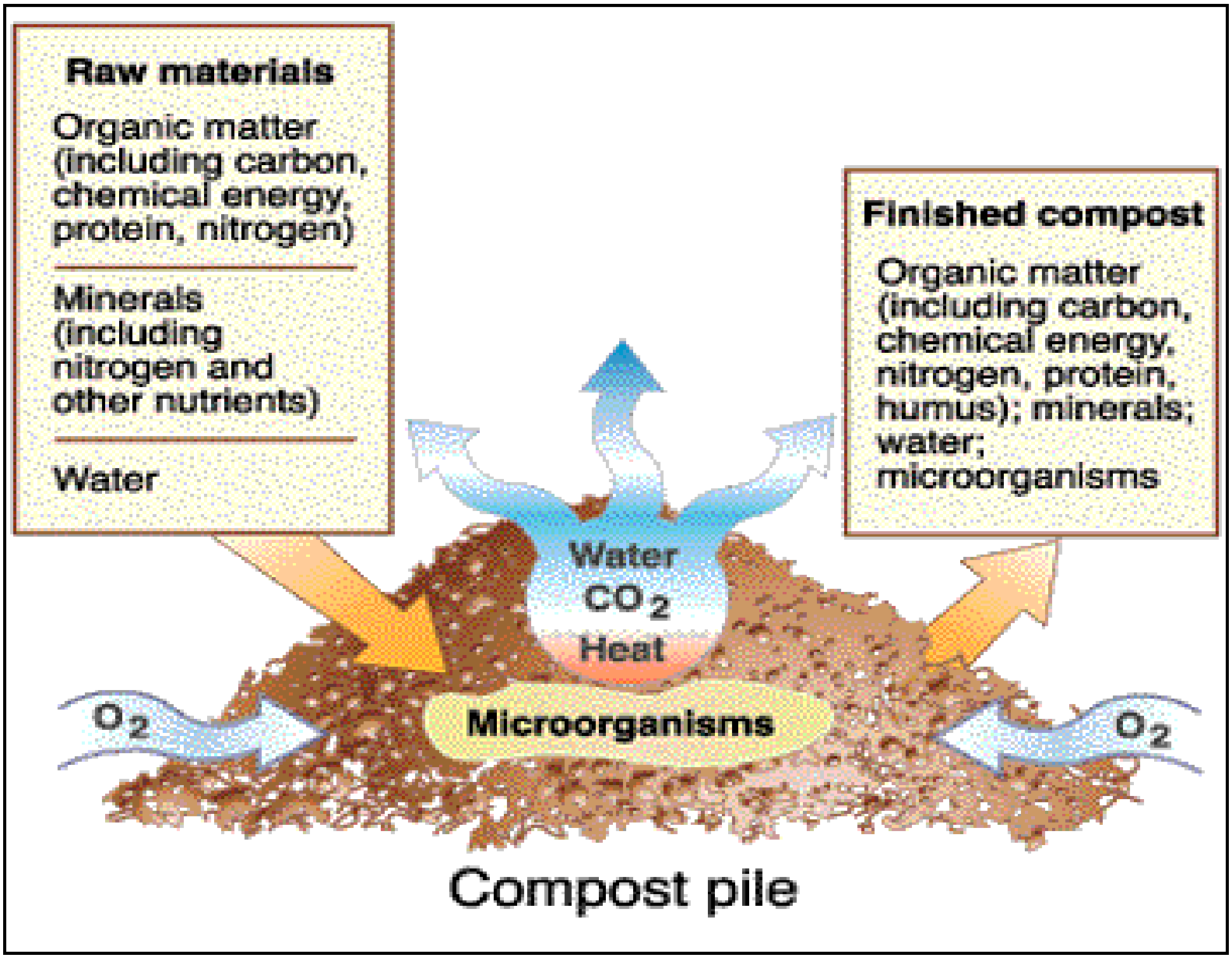
CaFe CB Mg Cl Mn

Mo Cu Zn

pH

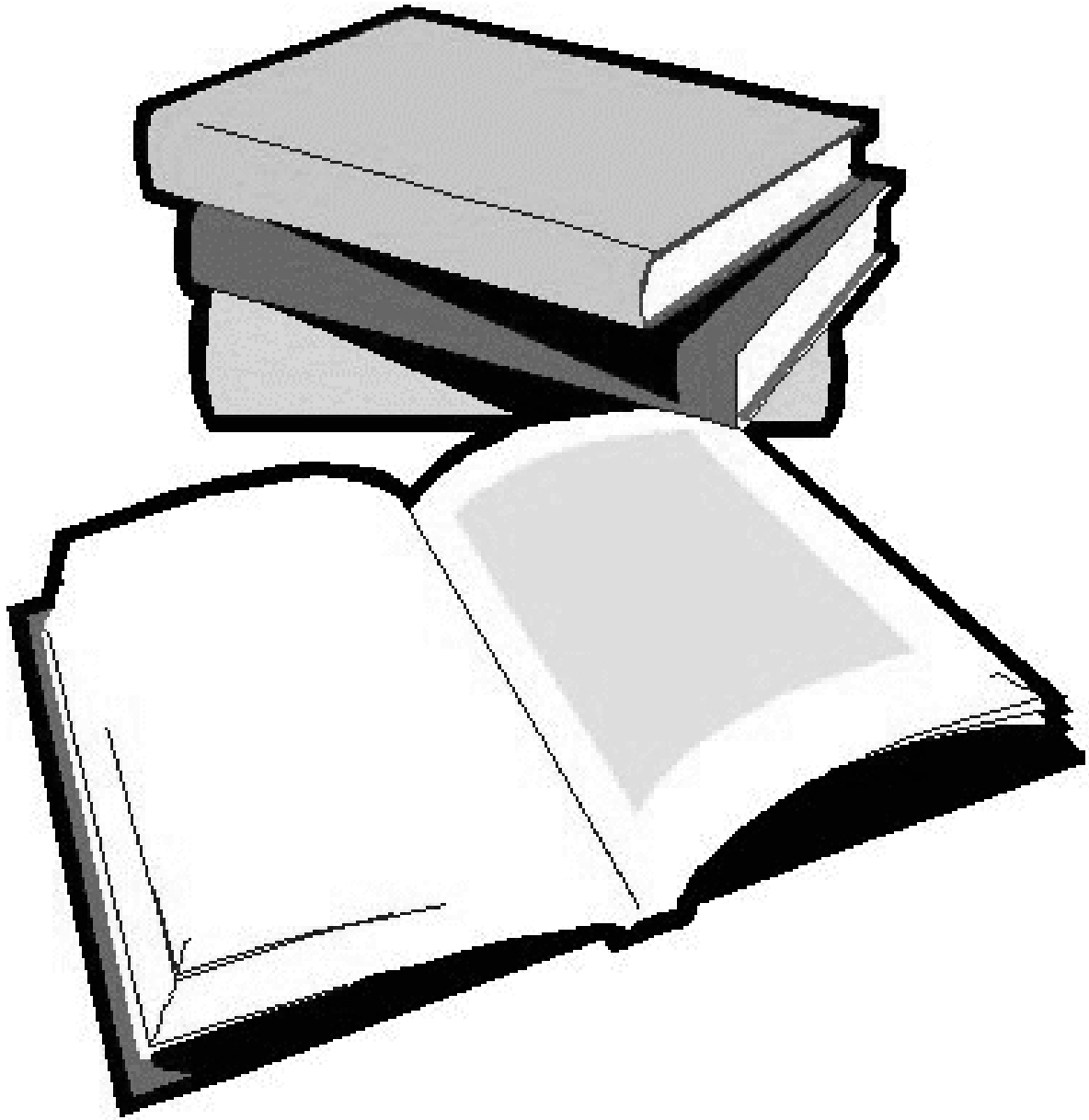
- pH is the log rhythm of Hydrogen ions
- Log rhythms are by the power of ten
- Each number change on the pH scale then is times 10



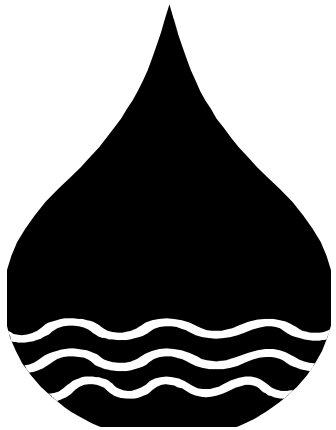

Raw materials
Organic matter (including carbon, chemical energy, protein, nitrogen)
Minerals (including nitrogen and other nutrients)
Water
Finished compost
Organic matter (including carbon, chemical energy, nitrogen, protein, humus); minerals; water; microorganisms
Water
CO_2
Heat
Microorganisms
O_2
O_2
Compost pile

Physical Factors Affecting Composting

Surface Area



Water

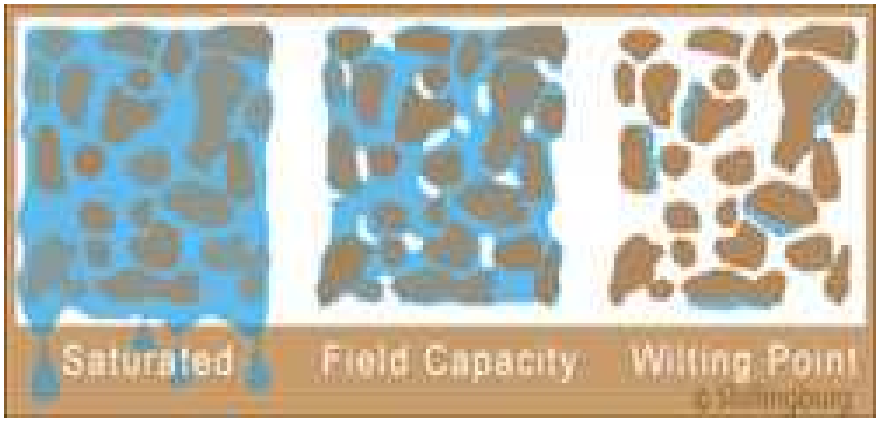


The right balance nourishes microbial organisms

Target Range: 50-60% by weight

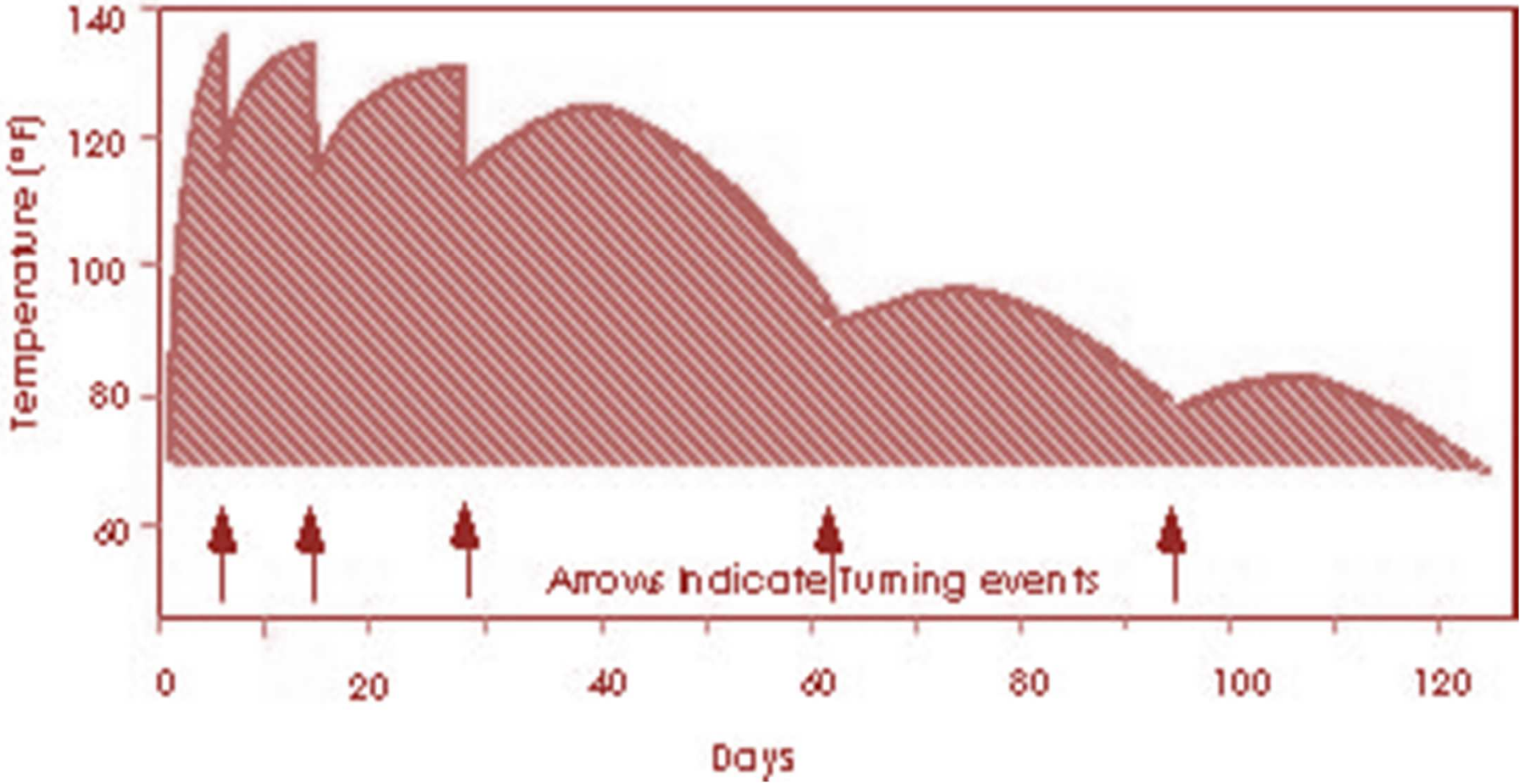
Measuring % Moisture

$$\frac{\text{Weight of wet sample} - \text{weight of dry sample}}{\text{Weight of wet sample}} \times 100$$



Temperature: Pop Quiz

Typical Temperature Profile



How Temperatures Affect the Process

Temperature Ranges

Low → Medium → High

(55°F) (70-100°F) (100-150°F)

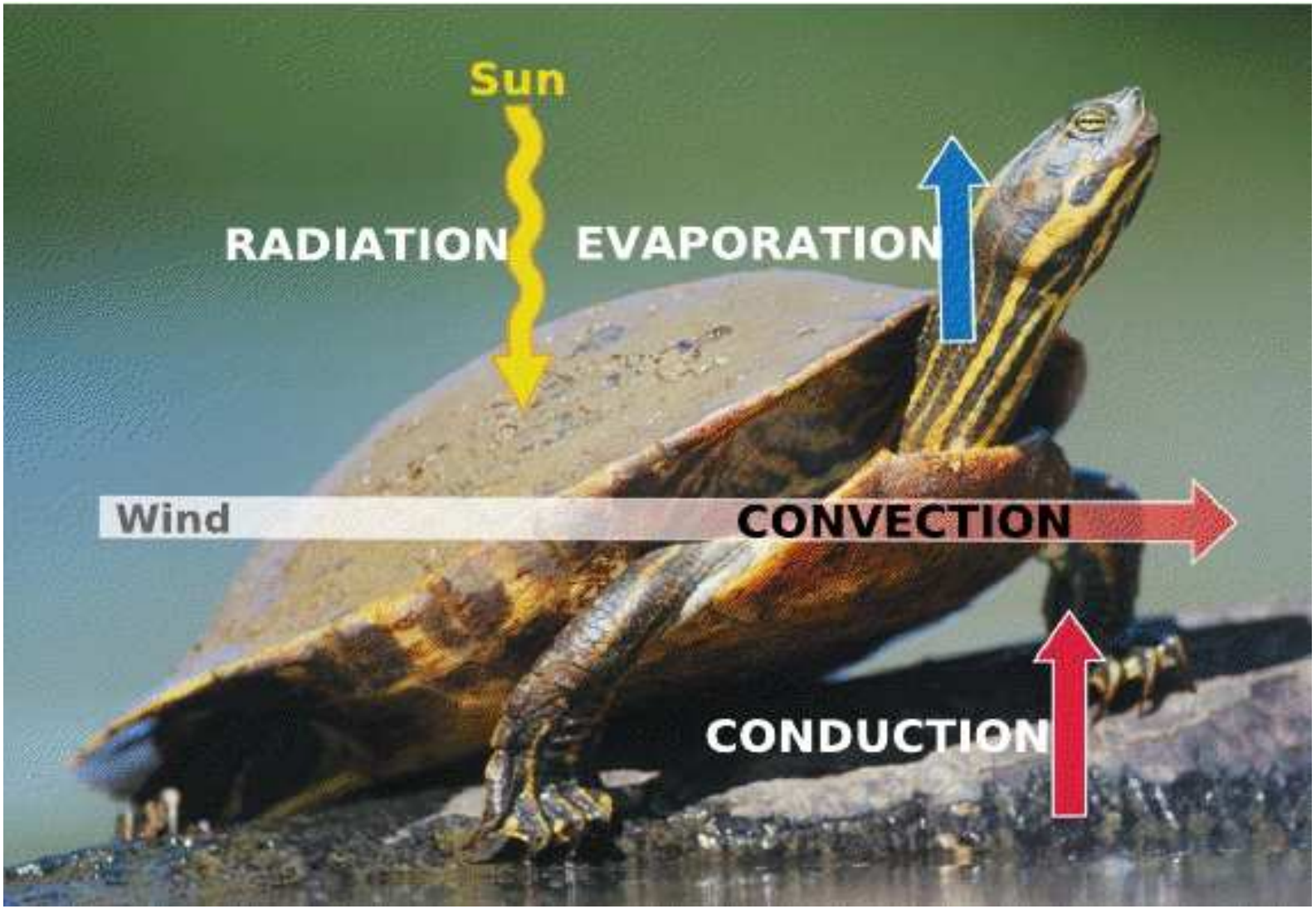
Microbial Activity

Low → Medium → High

Decomposition Speed

Low → Medium → High

Mechanisms for Heat Loss



Time

C:N ratio, oxygen, moisture, particle size, mixing and temperatures effect the time it takes to reach stable compost

Factors That Affect Composting

- Feed stocks
- C:N Ratio
- Moisture Content
- Organic matter content
- pH
- Porosity, bulk density
- Particle size
- Aeration
- Turning frequency
- Configuration

Bulk density is measured in pounds per cubic yard

For example:

Grass clippings	:	300-400 lbs./cy
Leaves	:	100-300 lbs./cy
Shrub trimmings	:	400-450 lbs./cy
Tree trimmings	:	1000-1300 lbs./cy
Wood chips	:	440-620 lbs./cy
Food	:	1800-2000 lbs./cy

Winter source bulking agent

Odor Problems Occur when . . .

LEADING THE WAY

NEWS | WEATHER | BLITZ5 | ULOCAL | ON TV | VIDEO | 1/2 OFF CINCY | PRE

Home / Local News

By Tammy Mutasa

Residents angry about smelly situation at former Compost Cincy site

City leaders say with cleanup, smell will get worse before better

Published 8:07 PM EDT Jul 14, 2014

Text Size A A A

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Advertising

CINCINNATI — *It's a nasty odor that can be smelled for miles.*

tion-at-former-compost-cincy-site/26951372

Principles to Minimize Odors

1. Increase oxygen availability
2. Correct moisture content
3. Adequate bulking agents, porosity, turning
4. Provide adequate C:N ratio of approximately 30:1
5. Adequate drainage on site

When is the compost finished?

Finished Compost Characteristics

- Stable heat and pH levels
- Humification complete
- C:N Ratio is about 10:1
- Lack of odors (smells like fresh soil)
- Seed germination test
- Plant growth
- Consistent odor, bulk density, particle size

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END

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